

IEEE Standards Interpretation for IEEE Std C57.111-1989

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Topic: Flash Point and Fire Point of Silicone Transformer Fluid.

Relevant Clause: Table 1 and Table 3.

Interpretation request

In IEEE Std C57.111-1989, **IEEE Guide for Acceptance of Silicone Transformer Fluid and Its Maintenance in Transformers**, Table 1 and Table 3 lists the test limits for silicone fluid as received and service-aged. The minimum flash point is listed as 300 degrees C (ASTM D92) with a minimum fire point of 340 degrees C (ASTM D-92) and a volatile matter limit of 0.5% by weight (ASTM D-4559). Table 3 titled "Test limits for service-aged silicone fluid" states that the minimum fire point for service aged silicone fluid is still 340 degrees C.

Tests have suggested that some virgin silicone fluid can pass the fire point test but not the flash point test. It appears that the volatile matter limit must be down to 250 PPM (0.025%) to get the flash point about 300 degrees C.

Why does IEEE Std C57.111-1989 require a minimum fire point of 340 degrees C while a temperature of 300 degrees C is required to meet the less flammable fire rating? Why is this standard more stringent than the Underwriters Laboratories, Factory Mutual, and IEEE C57.121-1988 set a minimum fire point of 300 degrees C?

Interpretation for IEEE Std IEEE Std C57.111-1989

C57.111-1989 was not intended to cover retrofilled transformers. This is stated clearly in the Scope and Purpose statement of the guide.

The NEC requires a minimum 300 degrees C fire point for any less flammable fluid. This was an arbitrary number established in the Code making process of the NFPA. Silicone fluids fit the "less-flammable" category, but not all "less-flammable" fluids are silicone. Fluids based on esters, vegetable oils, and high viscosity mineral oils also fit the broader "less-flammable" category of the NEC. Listing agencies, i.e., Factory Mutual and UL, have still other criteria for approving these fluids, well beyond flash and fire point tests.

The requirements for new silicone fluid are based on ASTM 4652 Standard Specification for Silicone Fluid Used for Electrical Insulation. It was based on a consensus of silicone fluid manufacturers and foreseen transformer requirements. The values for new transformers were based on the consensus of transformer manufacturers capability at the factory, and the in-service, normal values are what should be expected in operating units that came from the factory with silicone fluid when new. Values other than the ones listed indicate atypical units by this this definition. It does not necessarily mean there is anything wrong with the unit. One would expect different values in a unit that had been retrofilled and had residual levels of other fluids in the silicone.

There has been no complaints from the industry of new fluids not meeting the flash point spec level. It may well be that a lower volatility level is required to meet this requirement. ASTM 4559 actually is a combined stability and volatile content test, so that the total contribution to the value may not directly correlate to flash point. Also, the volatiles may consist of different components with different individual flash points, the lowest being the most important to the flash point result.

C57.12-1988 covers a material that is quite different from silicone based on high viscosity mineral oil. Essentially all of the descriptive physical properties are different, and the minimum fire point is notably lower simply because that was the level of commercial fluids at the time the standard was developed.

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